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Best Demonstrated Available Technology (BDAT) Background Document for K043 (Non-CBI Version) (Proposed)

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BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT FOR

K043

(Non-CBI Version)

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1. INTRODUCTION

Pursuant to section 3004(m) of the Resource Conservation and Recovery Act as enacted by the Hazardous and Solid Waste Amendments on November 8, 1984, the Environmental Protection Agency (EPA) is proposing Best Demonstrated Available Technology (BDAT) treatment standards for K043 waste (2,6-dichlorophenol waste from the production of 2,4-D). Compliance with the BDAT treatment standards is a prerequisite for the placement of the waste in facilities designated as land disposal units according to 40 CFR Part 268. The effective date of the K043 treatment standards will be June 8, 1989.

This background document provides the Agency's technical support for selecting and developing the proposed treatment standards for the constituents to be regulated in K043 waste. Section 2 presents waste-specific information--the number and location of facilities affected by the land disposal restrictions, the waste generating process, and waste characterization data. Section 3 discusses the technologies used to treat the waste (or similar wastes), and Section 4 presents available performance data, including data on which the proposed treatment standards are based. Section 5 explains EPA's determination of BDAT, while Section 6 discusses the selection of constituents to be regulated. The proposed treatment standards are determined in Section 7.

The BDAT program and promulgated methodology are more thoroughly described in two additional documents: Methodology for Developing BDAT Treatment Standards (USEPA 1988a) and Generic Quality Assurance Project Plan for Land Disposal Restrictions Program ("BDAT") (USEPA 1987). The petition process to be followed in requesting a variance from the BDAT treatment standards is discussed in the methodology document.

Thirteen constituents are being proposed for regulation in both nonwastewater and wastewater forms of K043 waste. For the purpose of determining the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1 percent (weight basis) total suspended solids* and less than 1 percent (weight basis) total organic carbon (TOC). Waste not meeting this definition must comply with the treatment standards for nonwastewaters.

The proposed treatment standards for the regulated volatile and semivolatile organic constituents in both nonwastewaters and wastewaters are based on performance data from incineration of K043 waste. The proposed treatment standards for the BDAT list polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are being transferred from the treatment standards for these constituents in K099 waste.

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*The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209c, Total Suspended Solids Dried at 103°-105°C, in Standard Methods for the Examination of Water and Wastewater, 16th Edition (APHA, AWWA, and WPCF 1985).

Table 1-1 lists the specific proposed nonwastewater and wastewater treatment standards for K043 waste. The treatment standards reflect the total constituent concentration; the units are mg/kg (parts per million on a weight-by-weight basis) for the nonwastewaters and mg/l (parts per million on a weight-by-volume basis) for the wastewaters. Note that if the concentrations of the regulated constituents in the waste, as generated, are lower than or equal to the proposed treatment standards, then treatment will not be required prior to land disposal.

Testing procedures for all sample analyses performed for the regulated constituents are specifically identified in Appendix A of this background document.

Table 1-1 Treatment Standards for K043 Waste

Constituent	Maximum for any single grab sample		
	Nonwastewaters		Wastewaters
	Total concentration (mg/kg)	TCLP leachate concentration (mg/l)	Total concentration (mg/l)
Volatile organics			
Tetrachloroethene	1.7	NA	0.006
Semivolatile organics			
2,4-Dichlorophenol	0.38	NA	0.06
2,6-Dichlorophenol	0.34	NA	0.006
Pentachlorophenol	1.9	NA	0.014
Tetrachlorophenols (total)	0.68	NA	0.02
2,4,5-Trichlorophenol	8.2	NA	0.025
2,4,6-Trichlorophenol	7.6	NA	0.017
Dioxins and furans			
Hexachlorodibenzo-p-dioxins	0.001	NA	0.001
Hexachlorodibenzofurans	0.001	NA	0.001
Pentachlorodibenzo-p-dioxins	0.001	NA	0.001
Pentachlorodibenzofurans	0.001	NA	0.001
Tetrachlorodibenzo-p-dioxins	0.001	NA	0.001
Tetrachlorodibenzofurans	0.001	NA	0.001

NA = Not applicable.

2. INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

According to 40 CFR 261.32, the waste K043 is listed as follows:

K043: 2,6-Dichlorophenol waste from the production of 2,4-D (2,4-dichlorophenoxyacetic acid).

This section describes the K043 waste, its generation, and the industry affected by the land disposal restriction of the waste.

2.1 Industry Affected and Process Description

2,4-Dichlorophenoxyacetic acid (2,4-D) and (subsequently) K043 waste are generated by the pesticides industry (Standard Industrial Classification (SIC) code 2818). The Agency knows of one facility that currently produces 2,4-D and generates K043 waste: Dow Chemical U.S.A., located in Midland, Michigan, EPA Region V.

In the 2,4-D manufacturing process, phenol is chlorinated to 2,4-dichlorophenol (2,4-DCP), an intermediate that is later reacted with chloroacetic acid in the presence of sodium hydroxide, hydrochloric acid, and a catalyst to form 2,4-D. The chlorination process step results in the formation of byproducts such as 2,6-dichlorophenol (2,6-DCP) and 2,4,6-trichlorophenol (2,4,6-TCP). In Dow Chemical's process, [

MISSING INFORMATION IS RCRA CONFIDENTIAL BUSINESS INFORMATION (CBI)

2.2 Waste Characterization

Available characterization data indicate that K043 waste contains primarily chlorinated organic compounds, less than 2 percent ash, and no water. The total organic carbon and halogen contents have been reported at 44 and 32 percent, respectively. The heating value ranges from 5,000 to 10,000 Btu per pound. The waste, a solid at room temperature, becomes a liquid at elevated temperatures. (The melting point of 2,4-DCP and 2,4,6-TCP are approximately 43° and 68°C, respectively.)

Table 2-1 provides an approximation of the composition of K043 waste, which is based on the available waste characterization data summarized in Table 2-2.

Table 2-1 General Composition of K043 Waste

Constituent	Concentration (%)
Chlorinated organics	>96
Ash (metals and other inorganics)	<2
Water	0

Table 2-2 Summary of K043 Waste Characterization Data

Constituent/parameter	Concentration (ppm or as otherwise noted) (1)	(2)	(3)	(4)	(5)
BDAT list volatile organics					
Tetrachlorethene	-	-	-		[MISSING INFORMATION IS CBI.]
BDAT list semivolatile organics					
2-Chlorophenol	-	-	-		
o-Cresol	-	-	-		
m- and p-Cresol	-	-	-		
2,4-Dichlorophenol	46,000	80,000	-		
2,6-Dichlorophenol	15,000	20,000	-		
2,4-Dimethylphenol	-	-	-		
2,4-Dinitrophenol	-	-	-		
4,6-Dinitro-o-cresol	-	-	-		
4-Nitrophenol	-	-	-		
Pentachlorophenol	-	-	-		
Phenol	-	-	-		
Tetrachlorophenols	-	-	-		
2,4,5-Trichlorophenol	-	-	-		
2,4,6-Trichlorophenol	20,000	350,000			
BDAT list dioxins and furans					
Hexachlorodibenzo-p-dioxins	-	-	-		
Hexachlorodibenzofurans	-	-	-		
Pentachlorodibenzo-p-dioxins	-	-	-		
Pentachlorodibenzofurans	-	-	-		
2,3,7,8-Tetrachlorodibenzo-p-dioxin	-	-	0.020		
Tetrachlorodibenzo-p-dioxins	-	-	-		
Tetrachlorodibenzofurans	-	-	-		
BDAT list phenoxyacetic acid herbicides					
2,4-Dichlorophenoxyacetic acid	96,000	-	-		
2,4,5-Trichlorophenoxyacetic acid	266,000	-	-		
Non-BDAT list organics					
Chlorophenol polymers	-	550,000	-		
2-Chloro-3-methylphenol	-	-	-		
2,6-Dichlorophenoxyacetic acid	359,000	-	-		
2,4,6-Trichlorophenoxyacetic acid	121,000	-	-		
o-Chlorophenoxyacetic acid	23,000	-	-		
p-Chlorophenoxyacetic acid	23,000	-	-		
2-Nitrophenol	-	-	-		
BDAT and non-BDAT list metals					
Aluminum	-	-	-		
Barium	-	-	-		
Beryllium	-	-	-		

Table 2-2 (continued)

Constituent/parameter	Concentration (ppm or as otherwise noted) (1)	(2)	(3)	(4)	(5)
Metals (continued)					
Boron	-	-	-	[MISSING INFORMATION	
Cadmium	-	-	-	IS CBI.]	
Calcium	-	-	-		
Chromium	-	-	-		
Cobalt	-	-	-		
Copper	-	-	-		
Iron	-	-	-		
Lead	-	-	-		
Lithium	-	-	-		
Magnesium	-	-	-		
Manganese	-	-	-		
Molybdenum	-	-	-		
Nickel	-	-	-		
Potassium	-	-	-		
Silver	-	-	-		
Sodium	-	-	-		
Strontium	-	-	-		
Tin	-	-	-		
Titanium	-	-	-		
Vanadium	-	-	-		
Yttrium	-	-	-		
Zinc	-	-	-		
Other parameters					
Solids	100%	-	-	-	-
Total organic carbon	44%	-	-	-	-
Total organic halogens	32%	-	-	-	-
Ash	0%	-	-	-	<2%
Specific gravity	1.35	-	-	-	-
Heating value	23240 kJ/kg (9998 Btu/lb)		-	-	5000-10000 Btu/lb

- = Either not reported or not analyzed.

[a]Concentrations in TCLP extract of the waste.

References:

(1) Environ 1985 (data on waste from a Vertac Chemical Corporation plant, which is no longer in operation).

(2) Hooper 1981 (as cited in Versar 1986).

(3) Dow Chemical 1984 (data on waste from Dow Chemical plant in Midland, Michigan).

(4) MRI 1987 (data on waste from Dow Chemical plant in Midland, Michigan).

(5) Letter dated August 19, 1988, from S. L. Arnold, Dow Chemical, to J. Vorbach, U.S. EPA, regarding Dow response to EPA/RCRA 3007 request for information on K043 waste (data on waste from Dow Chemical plant in Midland, Michigan).

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3. APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section identifies the treatment technologies that are applicable to K043 waste and determines which, if any, of the applicable technologies can be considered demonstrated for the purposes of establishing BDAT.

To be applicable, a technology must be theoretically usable to treat the waste in question, or to treat a waste that is similar in terms of the parameters that affect treatment selection. (For detailed descriptions of the technologies applicable for these wastes, or for wastes judged to be similar, see EPA's Treatment Technology Background Document (USEPA 1988b).) To be demonstrated, the technology must be employed in full-scale operation for the treatment of the waste in question or a similar waste. Technologies available only at research facilities or at pilot- and bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

As shown in Section 2.2, K043 waste contains primarily organic constituents and traces of BDAT list metals. Applicable technologies for the organic constituents in the waste or any resulting treatment residuals include technologies that destroy or reduce the amount of constituent present in the waste. Applicable technologies for the metals could include those that remove or prevent migration of metal constituents from the waste.

The Agency has identified fuel substitution and incineration as applicable technologies for treating the organic constituents in untreated K043 waste. As treatment processes, fuel substitution and incineration have the same purpose: to thermally destroy the organic constituents in the waste by converting them to carbon dioxide and water. Fuel substitution additionally uses the waste as a substitute for conventional fuels burned in high temperature industrial processes. Both fuel substitution and incineration generally result in nonwastewater and wastewater treatment residuals such as ash, clarifier solids from the scrubber system, and scrubber water, which may require further treatment. The residuals from treatment of K043 waste in a well-designed, well-operated fuel substitution combustion device or incinerator are not expected to contain detectable levels of organic constituents and thus should not require further treatment for organics.

Because K043 waste contains only trace amounts of BDAT list metals, residuals are not expected to contain treatable levels of these metals. Therefore, no applicable technologies have been identified for BDAT list metals in K043 waste.

3.2 Demonstrated Technologies

The only current generator of K043 waste uses a rotary kiln incineration system in which the heated waste, typically blended with other liquid wastes, is fed into the secondary combustion chamber (liquid injection unit). Therefore, incineration is demonstrated on K043 waste.

Fuel substitution, though demonstrated on wastes having similar high organic contents and heating values above 8,000 Btu per pound, is not considered to be demonstrated for K043 waste. The July 8, 1987, final rule for California List wastes (52 FR 25760) specifies that hazardous wastes containing halogenated organic compounds (HOCs) in total concentrations greater than or equal to 1,000 mg/kg, except dilute HOC wastewaters, must be incinerated in accordance with the requirements of 40 CFR Part 264 Subpart O or Part 265 Subpart O (standards and interim status standards, respectively, for owners and operators of facilities that incinerate hazardous wastes).

4. PERFORMANCE DATA BASE

This section presents the data available to EPA on the performance of demonstrated technologies in treating the listed wastes. These data are used elsewhere in this document for determining which technologies represent BDAT (Section 5), for selecting constituents to be regulated (Section 6), and for developing treatment standards (Section 7). Eligible data, in addition to full-scale demonstration data, may include data developed at research facilities or obtained through other applications at less than full-scale operation, as long as the technology is demonstrated in full-scale operation for a similar waste or wastes as defined in Section 3.

Performance data, to the extent that they are available to EPA, include the untreated and treated waste concentrations for a given constituent, values of operating parameters that were measured at the time the waste was being treated, values of relevant design parameters for the treatment technology, and data on waste characteristics that affect performance of the treatment technology.

Where data are not available on the treatment of the specific wastes of concern, the Agency may elect to transfer data on the treatment of a similar waste or wastes, using a demonstrated technology. To transfer data from another waste category, EPA must find that the wastes covered by this background document are no more difficult to treat (based on the waste characteristics that affect performance of the demonstrated treatment technology) than the treated wastes from which performance data are being transferred.

4.1 Nonwastewaters

Dow Chemical submitted data to the Agency from one test burn of K043 waste. During the test, one sample of untreated K043 was collected along with one sample of clarifier solids, two samples of scrubber water residuals, and two samples of scrubber makeup water. Analytical results for only seven organic compounds were reported. As shown on Table 4-1, the data for nonwastewater residuals are reported under the clarifier solids column. Because K043 waste is incinerated in the secondary combustion chamber of Dow Chemical's rotary kiln incineration system, the K043 waste does not contribute to the ash generated from the rotary kiln. Ash particulates from the secondary combustion chamber, however, are collected in the clarifier solids stream from the combustion gas scrubber system.

Operating data were not collected during the actual burn. Nominal values and design information are presented in Table 4-2. Because the rotary kiln incineration system is highly automated and no abnormalities were recorded during the test burn, the Agency believes that the data are representative of a well-designed and well-operated system.

EPA has no data for treatment of 2,3,7,8-TCDD or other PCDDs and PCDFs in K043 waste. The Agency, however, has data on the six BDAT list PCDDs and PCDFs in untreated and treated K099 waste (see USEPA 1988c). K099 waste is generated at the same site as K043 waste, in the next step of the 2,4-D production process. These K099 data indicate concentration levels of less than 1 ppb for each of the six BDAT list PCDDs and PCDFs

in the treated waste. Additionally, the Agency has data from the field demonstration of EPA's Mobile Incineration System on F020, F022, F023, F026, and F027 wastes at the Denney Farm site in McDowell, Missouri, which indicate that incineration is capable of treating dioxin-containing wastes to nondetectable levels. These data are discussed in the preamble to the final rule for dioxin-containing wastes (51 FR 40615, November 7, 1986).

4.2 Wastewaters

As mentioned in Section 4.1, EPA has data on seven organic constituents in two samples of scrubber water residuals and in two samples of scrubber makeup water from incineration of K043 waste (see Table 4-1). The scrubber water residuals represent treated K043 wastewater.

Table 4-1 Performance Data for Incineration of K043 Waste

Constituent	Concentration					
	Untreated waste (mg/kg)	Clarifier solids (mg/kg)	Scrubber water (mg/l)		Makeup water (mg/l)	
			Sample 1[a]	Sample 2[b]	Sample 1[a]	Sample 2[b]
Volatile organics						
Tetrachloroethane						
Semivolatile organics						
2,4-Dichlorophenol						
2,6-Dichlorophenol		[MISSING INFORMATION IS CBI.]				
Pentachlorophenol						
2,3,4,6-Tetrachlorophenol						
2,4,5-Trichlorophenol						
2,4,6-Trichlorophenol						

[a]Sample 1 of scrubber water and Sample 1 of makeup water were collected at the same time.
[b]Sample 2 of scrubber water and Sample 2 of makeup water were collected at the same time.
[c]Overwhelming quantity of 2,4,6-trichlorophenol prevented quantitation of closely eluting 2,4,5-trichlorophenol

Table 4-2 Nominal Operating and Design Information for Dow Chemical Rotary Kiln Incineration Used for K043 Test Burn

Parameter	Description

[MISSING INFORMATION IS CBI.]

5. IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the Agency's rationale for determining best demonstrated available technology (BDAT) for K043 nonwastewaters and wastewaters.

To determine BDAT, the Agency examines all available performance data on technologies that are identified as demonstrated to determine (using statistical techniques) whether one or more of the technologies performs significantly better than the others. All performance data used for determination of best technology must first be adjusted for accuracy, as discussed in EPA's publication Methodology for Developing BDAT Treatment Standards. (An accuracy adjustment accounts for the ability of an analytical technique to recover a particular constituent from the waste in a particular test. The recovery of a constituent is usually determined by spiking a sample with a known amount of the target constituent and then comparing the spiked sample amounts with results from unspiked samples.) BDAT must be specifically defined for all streams associated with the management of the listed waste or wastes; this pertains to the original waste as well as any residual waste streams created by the treatment process.

The technology that performs best on a particular waste or waste treatability group is then evaluated to determine whether it is "available." To be available, the technology must (1) be commercially available to any generator and (2) provide "substantial" treatment of the waste, as determined through evaluation of accuracy-adjusted data. In

determining whether treatment is substantial, EPA may consider data on the performance of a waste similar to the waste in question provided that the similar waste is at least as difficult to treat. If the best technology is found to be not available, then the next best technology is evaluated, and so on.

The determination of substantial treatment involves comparing constituent concentrations in the original waste to the respective concentrations in all residual streams from treatment. According to available data, incineration of K043 waste as generated (a nonwastewater) produces scrubber water (wastewater) and scrubber water clarifier solids (nonwastewater).

Incineration is the only technology identified as demonstrated for K043 waste. Thus, incineration is considered "best."

EPA has determined that incineration is commercially available. Also, EPA believes that incineration provides substantial treatment because the performance data show that untreated concentrations of chlorinated phenols and tetrachloroethene ranging from [CBI] mg/kg can be reduced to values ranging from [CBI] mg/kg (adjusted for accuracy as explained in Section 7) in the residual nonwastewater stream (the clarifier solids), and to less than [CBI] mg/ l (adjusted for accuracy as explained in Section 7) in the residual wastewater stream (the scrubber water). Thus, incineration is "available."

As "best," "demonstrated," and "available," incineration is therefore BDAT for K043 waste.

6. SELECTION OF REGULATED CONSTITUENTS

This section presents the rationale for the selection of regulated constituents for the treatment of K043 waste.

Constituents selected for regulation must satisfy the following criteria:

1. They must be on the BDAT list of regulated constituents. (Presence on the BDAT list implies the existence of approved techniques for analyzing the constituent in treated waste matrices.)

2. They must be present in, or be suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

3. Where performance data are transferred, the selected constituents must be easier to treat than the waste constituent(s) from which performance data are transferred. Factors for assessing ease of treatment vary according to the technology of concern. For instance, for incineration the factors include bond dissociation energy, thermal conductivity, and boiling point.

From the group of constituents that are eligible to be regulated, EPA may select a subset of constituents as representative of the broader group. For example, out of a group of constituents that react similarly to treatment, the Agency might name only those that are the most difficult to treat as regulated constituents for the purpose of setting a standard.

6.1 Identification of BDAT List Constituents

As discussed in Sections 2 and 4, the Agency has characterization data (see Table 2-2) for K043 waste as well as performance data from treatment of this waste by incineration (see Table 4-1). These data,

along with information on the waste generating process, have been used to determine which BDAT list constituents are or may be present in the waste and thus which ones are potential candidates for regulation. Table 6-1 (at the end of this section) indicates, for the untreated waste, which constituents were analyzed, which constituents were detected, and which constituents the Agency believes may also be present.

Under the column "Believed to be present," constituents other than those detected in untreated K043 waste are marked with an X or a Y if EPA believes they are likely to be present in the untreated waste. An X indicates that the Agency believes that the waste-generating process could produce these constituents, while a Y indicates that they have been detected in the treated residuals. Such constituents may not have been detected in the untreated waste because either the untreated waste samples were not analyzed for those constituents or masking or interference by other constituents prevented detection.

As shown in Table 6-1, the K043 waste samples for which the Agency has data were analyzed for 33 of the 231 BDAT list constituents. Seventeen of the 33 constituents were actually detected in the untreated wastes or treated residuals; four additional PCDDs and PCDFs are believed to potentially be present. These 21 constituents, listed in Table 6-2, are considered candidates for regulation.

6.2 Constituent Selection

The Agency is proposing to regulate 13 of the 21 candidates either detected or believed to be present in K043 waste. The regulated constituents include the seven volatile and semivolatile candidates as

well as the hexa-, penta-, and tetrachlorodibenzo-p-dioxins and the hexa-, penta-, and tetrachlorodibenzofurans. (2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is being regulated as a subset of tetrachlorodibenzo-p-dioxins.)

EPA is not proposing to regulate any metals because their concentrations are at trace or nondetectable levels in the untreated waste, and because the metals are expected to be present at nontreatable concentrations in the clarifier solids and scrubber water generated from incineration of K043 waste.

Though identified as being present at fairly high concentrations in some K043 wastes (see Table 2-2), 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) are not being proposed for regulation for the following reasons. First, the data showing the high concentrations of 2,4-D and 2,4,5-T are from a former generator of the waste. This former generator produced the 2,4-D product using a process that differs from that of the current sole generator. K043 waste is generated in the first step of the sole generator's two-step process following production of the 2,4-DCP intermediate, prior to production of 2,4-D. Therefore, the Agency does not expect 2,4-D or 2,4,5-T to be present in the current generator's K043 waste. Second, for K043 waste potentially produced by a different process, the Agency believes that regulation of TCDDs would ensure adequate treatment of 2,4-D and 2,4,5-T if they were present. This belief is based on the difference in bond dissociation energies of these constituents. The bond dissociation

energy is a waste characteristic affecting the performance of incineration. In general, the higher the bond dissociation energy, the more difficult it is to combust and thus treat a constituent. The calculated bond dissociation energy of any TCDD isomer is approximately 2600 kcal/mole, while bond dissociation energies for 2,4-D and 2,4,5-T are calculated at approximately 2050 kcal/mole. (These bond dissociation calculations can be found in the Administrative Record for K043.)

Table 6-1 Status of BDAT List Constituent Presence in Untreated K043 Waste

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Volatile organics		
222.	Acetone	NA	
1.	Acetonitrile	NA	
2.	Acrolein	NA	
3.	Acrylonitrile	NA	
4.	Benzene	NA	
5.	Bromodichloromethane	NA	
6.	Bromomethane	NA	
223.	n-Butyl alcohol	NA	
7.	Carbon tetrachloride	NA	
8.	Carbon disulfide	NA	
9.	Chlorobenzene	NA	
10.	2-Chloro-1,3-butadiene	NA	
11.	Chlorodibromomethane	NA	
12.	Chloroethane	NA	
13.	2-Chloroethyl vinyl ether	NA	
14.	Chloroform	NA	
15.	Chloromethane	NA	
16.	3-Chloropropene	NA	
17.	1,2-Dibromo-3-chloropropane	NA	
18.	1,2-Dibromoethane	NA	
19.	Dibromomethane	NA	
20.	trans-1,4-Dichloro-2-butene	NA	
21.	Dichlorodifluoromethane	NA	
22.	1,1-Dichloroethane	NA	
23.	1,2-Dichloroethane	NA	
24.	1,1-Dichloroethylene	NA	
25.	trans-1,2-Dichloroethene	NA	
26.	1,2-Dichloropropane	NA	
27.	trans-1,3-Dichloropropene	NA	
28.	cis-1,3-Dichloropropene	NA	
29.	1,4-Dioxane	NA	
224.	2-Ethoxyethanol	NA	
225.	Ethyl acetate	NA	
226.	Ethyl benzene	NA	
30.	Ethyl cyanide	NA	
227.	Ethyl ether	NA	
31.	Ethyl methacrylate	NA	
214.	Ethylene oxide	NA	
32.	Iodomethane	NA	
33.	Isobutyl alcohol	NA	
228.	Methanol	NA	
34.	Methyl ethyl ketone	NA	

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Table 6-1 (continued)

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Volatile organics (continued)		
229.	Methyl isobutyl ketone	NA	
35.	Methyl methacrylate	NA	
37.	Methacrylonitrile	NA	
38.	Methylene chloride	NA	
230.	2-Nitropropane	NA	
39.	Pyridine	NA	
40.	1,1,1,2-Tetrachloroethane	NA	
41.	1,1,2,2-Tetrachloroethane	NA	
42.	Tetrachloroethene	[CBI]	
43.	Toluene	NA	
44.	Tribromomethane	NA	
45.	1,1,1-Trichloroethane	NA	
46.	1,1,2-Trichloroethane	NA	
47.	Trichloroethene	NA	
48.	Trichloromonofluoromethane	NA	
49.	1,2,3-Trichloropropane	NA	
231.	1,1,2-Trichloro-1,2,2-trifluoroethane	NA	
50.	Vinyl chloride	NA	
215.	1,2-Xylene	NA	
216.	1,3-Xylene	NA	
217.	1,4-Xylene	NA	
	Semivolatile organics		
51.	Acenaphthalene	NA	
52.	Acenaphthene	NA	
53.	Acetophenone	NA	
54.	2-Acetylaminofluorene	NA	
55.	4-Aminobiphenyl	NA	
56.	Aniline	NA	
57.	Anthracene	NA	
58.	Aramite	NA	
59.	Benz(a)anthracene	NA	
218.	Benzal chloride	NA	
60.	Benzenethiol	NA	
61.	Deleted		
62.	Benzo(a)pyrene	NA	
63.	Benzo(b)fluoranthene	NA	
64.	Benzo(ghi)perylene	NA	
65.	Benzo(k)fluoranthene	NA	
66.	p-Benzoquinone	NA	

Table 6-1 (continued)

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Semivolatile organics (continued)		
67.	Bis(2-chloroethoxy)methane	NA	
68.	Bis(2-chloroethyl)ether	NA	
69.	Bis(2-chloroisopropyl)ether	NA	
70.	Bis(2-ethylhexyl)phthalate	NA	
71.	4-Bromophenyl phenyl ether	NA	
72.	Butyl benzyl phthalate	NA	
73.	2-sec-Butyl-4,6-dinitrophenol	NA	
74.	p-Chloroaniline	NA	
75.	Chlorobenzilate	NA	
76.	p-Chloro-m-cresol	NA	
77.	2-Chloronaphthalene	NA	
78.	2-Chlorophenol	ND	
79.	3-Chloropropionitrile	NA	
80.	Chrysene	NA	
81.	ortho-Cresol	ND	
82.	para-Cresol	ND	
232.	Cyclohexanone	NA	
83.	Dibenz(a,h)anthracene	NA	
84.	Dibenzo(a,e)pyrene	NA	
85.	Dibenzo(a,i)pyrene	NA	
86.	m-Dichlorobenzene	NA	
87.	o-Dichlorobenzene	NA	
88.	p-Dichlorobenzene	NA	
89.	3,3'-Dichlorobenzidine	NA	
90.	2,4-Dichlorophenol	[CBI]	
91.	2,6-Dichlorophenol	[CBI]	
92.	Diethyl phthalate	NA	
93.	3,3'-Dimethoxybenzidine	NA	
94.	p-Dimethylaminoazobenzene	NA	
95.	3,3'-Dimethylbenzidine	NA	
96.	2,4-Dimethylphenol	ND	
97.	Dimethyl phthalate	NA	
98.	Di-n-butyl phthalate	NA	
99.	1,4-Dinitrobenzene	NA	
100.	4,6-Dinitro-o-cresol	NA	
101.	2,4-Dinitrophenol	ND	
102.	2,4-Dinitrotoluene	NA	
103.	2,6-Dinitrotoluene	NA	
104.	Di-n-octyl phthalate	NA	
105.	Di-n-propylnitrosamine	NA	
106.	Diphenylamine	NA	
219.	Diphenylnitrosamine	NA	

Table 6-1 (continued)

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Semivolatile organics (continued)		
107.	1,2-Diphenylhydrazine	NA	
108.	Fluoranthene	NA	
109.	Fluorene	NA	
110.	Hexachlorobenzene	NA	
111.	Hexachlorobutadiene	NA	
112.	Hexachlorocyclopentadiene	NA	
113.	Hexachloroethane	NA	
114.	Hexachlorophene	NA	
115.	Hexachloropropene	NA	
116.	Indeno(1,2,3-cd)pyrene	NA	
117.	Isosafrole	NA	
118.	Methapyrilene	NA	
119.	3-Methylcholanthrene	NA	
120.	4,4'-Methylenebis (2-chloroaniline)	NA	
36.	Methyl methanesulfonate	NA	
121.	Naphthalene	NA	
122.	1,4-Naphthoquinone	NA	
123.	1-Naphthylamine	NA	
124.	2-Naphthylamine	NA	
125.	p-Nitroaniline	NA	
126.	Nitrobenzene	NA	
127.	4-Nitrophenol	ND	
128.	N-Nitrosodi-n-butylamine	NA	
129.	N-Nitrosodiethylamine	NA	
130.	N-Nitrosodimethylamine	NA	
131.	N-Nitrosomethylethylamine	NA	
132.	N-Nitrosomorpholine	NA	
133.	N-Nitrosopiperidine	NA	
134.	N-Nitrosopyrrolidine	NA	
135.	5-Nitro-o-toluidine	NA	
136.	Pentachlorobenzene	NA	
137.	Pentachloroethane	NA	
138.	Pentachloronitrobenzene	NA	
139.	Pentachlorophenol	[CBI]	
140.	Phenacetin	NA	
141.	Phenanthrene	NA	
142.	Phenol	ND	
220.	Phthalic anhydride	NA	
143.	2-Picoline	NA	
144.	Pronamide	NA	
145.	Pyrene	NA	
146.	Resorcinol	NA	

Table 6-1 (continued)

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Semivolatile organics (continued)		
147.	Safrole	NA	
148.	1,2,4,5-Tetrachlorobenzene	NA	
149.	2,3,4,6-Tetrachlorophenol	[CBI]	
150.	1,2,4-Trichlorobenzene	NA	
151.	2,4,5-Trichlorophenol	ND	Y
152.	2,4,6-Trichlorophenol	[CBI]	
153.	Tris(2,3-dibromopropyl) phosphate	NA	
	Metals		
154.	Antimony	NA	
155.	Arsenic	NA	
156.	Barium	[CBI]	
157.	Beryllium	ND	
158.	Cadmium	ND	
159.	Chromium (total)	[CBI]	
221.	Chromium (hexavalent)	NA	
160.	Copper	[CBI]	
161.	Lead	ND	
162.	Mercury	NA	
163.	Nickel	[CBI]	
164.	Selenium	NA	
165.	Silver	ND	
166.	Thallium	NA	
167.	Vanadium	ND	
168.	Zinc	[CBI]	
	Inorganics other than metals		
169.	Cyanide	NA	
170.	Fluoride	NA	
171.	Sulfide	NA	
	Organochlorine pesticides		
172.	Aldrin	NA	
173.	alpha-BHC	NA	
174.	beta-BHC	NA	
175.	delta-BHC	NA	

Table 6-1 (continued)

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Organochlorine pesticides (continued)		
176.	gamma-BHC	NA	
177.	Chlordane	NA	
178.	DDD	NA	
179.	DDE	NA	
180.	DDT	NA	
181.	Dieldrin	NA	
182.	Endosulfan I	NA	
183.	Endosulfan II	NA	
184.	Endrin	NA	
185.	Endrin aldehyde	NA	
186.	Heptachlor	NA	
187.	Heptachlor epoxide	NA	
188.	Isodrin	NA	
189.	Kepone	NA	
190.	Methoxyclor	NA	
191.	Toxaphene	NA	
	Phenoxyacetic acid herbicides		
192.	2,4-Dichlorophenoxyacetic acid	96,000[c]	
193.	Silvex	NA	
194.	2,4,5-Trichlorophenoxyacetic acid	261,000[c]	
	Organophosphorous insecticides		
195.	Disulfoton	NA	
196.	Famphur	NA	
197.	Methyl parathion	NA	
198.	Parathion	NA	
199.	Phorate	NA	
	PCBs		
200.	Aroclor 1016	NA	
201.	Aroclor 1221	NA	
202.	Aroclor 1232	NA	
203.	Aroclor 1242	NA	
204.	Aroclor 1248	NA	
205.	Aroclor 1254	NA	
206.	Aroclor 1260	NA	

Table 6-1 (continued)

BDAT reference no.	Constituent	Presence in untreated waste (mg/kg)[a]	Believed to be present
	Dioxins and furans		
207.	Hexachlorodibenzo-p-dioxins	ND[d]	X
208.	Hexachlorodibenzofurans	ND[d]	X
209.	Pentachlorodibenzo-p-dioxins	ND[d]	X
210.	Pentachlorodibenzofurans	ND[d]	X
211.	Tetrachlorodibenzo-p-dioxins	[CBI][d]	
212.	Tetrachlorodibenzofurans	[CBI][d]	
213.	2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.020	

ND = Not detected (see Table 2-2 for detection limits).
NA = Not analyzed.
X = Believed to be present based on analysis of waste-generating process.
Y = Believed to be present based on detection in treated residuals.

[a]If detected, concentration is shown.
[b]Concentration range is for tetrachlorophenols, not the specific BDAT list constituent, 2,3,4,6-tetrachlorophenol.
[c]These concentrations were reported for a K043 waste from a Vertac Chemical Corporation plant, which is no longer in operation.
[d]Concentration in the TCLP extract of untreated waste.

Table 6-2 Potential Candidates for Regulation

Constituent
Volatile organics
Tetrachloroethene[a]
Semivolatile organics
2,4-Dichlorophenol[a]
2,6-Dichlorophenol[a]
Pentachlorophenol[a]
Tetrachlorophenols[a,b]
2,4,5-Trichlorophenol[a]
2,4,6-Trichlorophenol[a]
Metals
Barium
Chromium
Copper
Nickel
Zinc
Dioxins and furans
Hexachlorodibenzo-p-dioxins[a]
Hexachlorodibenzofurans[a]
Pentachlorodibenzo-p-dioxins[a]
Pentachlorodibenzofurans[a]
Tetrachlorodibenzo-p-dioxins[a]
Tetrachlorodibenzofurans[a]
2,3,7,8-Tetrachlorodibenzo-p-dioxin[c]
Phenoxyacetic acid herbicides
2,4-Dichlorophenoxyacetic
2,4,5-Trichlorophenoxyacetic acid

[a]These constituents are selected for regulation.

[b]Tetrachlorophenols are being used as a surrogate for the BDAT list constituent, 2,3,4,6-tetrachlorophenol.

[c]2,3,7,8-TCDD is being regulated as a subset of tetrachlorodibenzo-p-dioxins.

7. DEVELOPMENT OF BDAT TREATMENT STANDARDS

The Agency bases treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available performance data and must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures.

BDAT standards are determined for each constituent by multiplying the arithmetic mean of accuracy-adjusted constituent concentrations detected in the treated waste by a "variability factor" specific to each constituent. Accuracy adjustment of performance data was discussed in Section 5 in relation to defining "substantial treatment." Variability factors correct for normal variations in the performance of a particular technology over time. They are designed to reflect the 99th percentile level of performance that the technology achieves in commercial operation.

Where EPA has identified BDAT for a particular waste, but because of data limitations or for some other compelling reason cannot define specific treatment standards for that waste, the Agency can require the use of that treatment process as a technology standard. Similarly, where there are no known generators of a waste, or where EPA believes that the waste can be totally recycled or reused as a raw material, the Agency may specify a "no land disposal" standard, which effectively amounts to setting the performance standard at zero for all waste constituents.

In the case of K043 waste, the Agency is setting treatment standards for the volatile and semivolatile constituents shown in Tables 7-1 and 7-2. These treatment standards are based on the performance data from incineration of K043 waste (see Table 4-1).

The accuracy-adjusted concentration for a constituent in a matrix is the analytical result multiplied by the correction factor (the reciprocal of the recovery fraction*). For example, if Compound A is measured at 2.55 mg/l and the recovery is 85 percent, the accuracy-adjusted concentration is 3.00 mg/l:

2.55 mg/l	x	1/0.85	=	3.00 mg/l
(analytical result)		(correction factor)		(accuracy-adjusted concentration)

Recovery information for the K043 incineration performance data is summarized in Table 7-3.

EPA is using a variability factor of 2.8 for all the volatile and semivolatile treatment standard calculations because of the limited number of data points available for each constituent. EPA's publication Methodology for Developing BDAT Treatment Standards details both accuracy adjustment and the use of the 2.8 variability factor.

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*The recovery fraction is the ratio of (1) the measured amount of constituent (or surrogate) in a spiked aliquot minus the measured amount of constituent (or surrogate) in the original unspiked aliquot to (2) the known amount of constituent (or surrogate) added to spike the original aliquot. (Refer to the Generic Quality Assurance Project Plan for Land Disposal Restriction Program ("BDAT").)

The Agency does not have performance data for PCDD and PCDF treatment in K043 waste. Treatment standards for this constituent are being transferred from the promulgated rule for K099 waste. The PCDD and PCDF standards are 0.001 mg/kg and 0.001 mg/l for nonwastewaters and wastewaters, respectively. These treatment standards represent the routinely achievable detection limits for PCDDs and PCDFs using method 8280 of SW-846 (40 CFR 261 Appendix X).

Table 7-4 summarizes all treatment standards being established for K043 waste. Note that concentrations are being expressed in terms of mg/kg and mg/l for nonwastewaters and wastewaters, respectively.

Table 7-1 Calculation of Nonwastewater Treatment Standards for Regulated Volatile and Semivolatile Constituents in K043 Waste

Constituent	Treated K043-clarifier solids unadjusted concentration (mg/l)	Correction factor[a]	Adjusted concentration (mg/l)	Variability factor[a]	Treatment standard (mg/l)
Volatile organics					
Tetrachloroethene				2.8	1.7
Semivolatile organics					
2,4 Dichlorophenol				2.8	0.38
2,6 Dichlorophenol		[MISSING INFORMATION IS CBI.]		2.8	0.34
Pentachlorophenol				2.8	1.9
Tetrachlorophenols				2.8	0.68
2,4,5 Trichlorophenol				2.8	8.2
2,4,6 Trichlorophenol				2.8	7.6

[a]See text for explanation.

Table 7-2 Calculation of Wastewater Treatment Standards for Regulated Volatile and Semivolatile Constituents in K043 Waste

Constituent	Treated K043-scrubber water unadjusted concentration (mg/l) Sample 1	Sample 2	Correction factor[a]	Adjusted concentration (mg/l) Sample 1	Sample 2	Average mean adjusted concentration (mg/l)	Variability factor[a]	Treatment standard (mg/l)
Volatile organics								
Tetrachloroethene							2.8	0.006
Semivolatile organics								
2,4 Dichlorophenol		[MISSING INFORMATION IS CBI.]					2.8	0.060
2,6 Dichlorophenol							2.8	0.006
Pentachlorophenol							2.8	0.014
Tetrachlorophenols							2.8	0.020
2,4,5-Trichlorophenol							2.8	0.025
2,4,6 Trichlorophenol							2.8	0.017

[a]See text for explanation.

[b]Adjusted concentrations are detection limits rather than the true calculated values. The Agency cannot base standards on or adjust concentrations lower than detection limits.

Table 7-3 Recovery Data for K043 Incineration Performance Data

Constituent	Matrix spike or surrogate recovery fractions	
	Nonwastewaters	Wastewaters
Volatile organics		
Tetrachloroethene		
Semivolatile organics		
2,4-Dichlorophenol		
2,6-Dichlorophenol		
Pentachlorophenol	[MISSING INFORMATION IS CBI.]	
Tetrachlorophenols		
2,4,5-Trichlorophenol		
2,4,6-Trichlorophenol		

[a]Represents recovery of surrogate compound, toluene-d8. EPA is using lowest value of 0.97 for the treatment standard calculation.
[b]Represents recovery of surrogate compound, toluene-d8.
[c]Represents recovery of surrogate compound, 2,4,6-tribromophenol.

Table 7-4 Treatment Standards for K043 Waste

Constituent	Maximum for any single grab sample		
	Nonwastewaters		Wastewaters
	Total concentration (mg/kg)	TCLP leachate concentration (mg/l)	Total concentration (mg/l)
Volatile organics			
Tetrachloroethene	1.7	NA	0.006
Semivolatile organics			
2,4-Dichlorophenol	0.38	NA	0.06
2,6-Dichlorophenol	0.34	NA	0.006
Pentachlorophenol	1.9	NA	0.014
Tetrachlorophenols (total)	0.68	NA	0.02
2,4,5-Trichlorophenol	8.2	NA	0.025
2,4,6-Trichlorophenol	7.6	NA	0.017
Dioxins and furans			
Hexachlorodibenzo-p-dioxins	0.001	NA	0.001
Hexachlorodibenzofurans	0.001	NA	0.001
Pentachlorodibenzo-p-dioxins	0.001	NA	0.001
Pentachlorodibenzofurans	0.001	NA	0.001
Tetrachlorodibenzo-p-dioxins	0.001	NA	0.001
Tetrachlorodibenzofurans	0.001	NA	0.001

NA = Not applicable.

8. REFERENCES

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APPENDIX A

ANALYTICAL METHODS

Table A-1 identifies the methods and procedures used for analyzing the regulated constituents in K043 waste and treatment residuals.

Table A-1 Analytical Methods for Regulated Constituents

Analysis/Methods	SW-846 method number
Volatile organics	
Purge-and-trap	5030
Gas Chromatography/Mass Spectrometry for Volatile Organics	8240
Semivolatile organics	
Continuous Liquid/Liquid Extraction (water)	3520
Soxhlet Extraction (solids)	3540
Gas Chromatography/Mass Spectrometry for Semivolatile Organics: Capillary Column Technique (water and solids)	8270
Gas Chromatography/Flame Ionization (waste)	8040
Dioxins and furans	
Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans	8280

Reference: USEPA 1986.

Table A-1 Analytical Methods for Regulated Constituents

Analysis/Methods	SW-846 method number
Volatile organics	
Purge-and-trap	5030
Gas Chromatography/Mass Spectrometry for Volatile Organics	8240
Semivolatile organics	
Continuous Liquid/Liquid Extraction (water)	3520
Soxhlet Extraction (solids)	3540
Gas Chromatography/Mass Spectrometry for Semivolatile Organics: Capillary Column Technique (water and solids)	8270
Gas Chromatography/Flame Ionization (waste)	8040
Dioxins and furans	
Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans	8280

Reference: USEPA 1986.